CLAIMS

I claim:

1. An apparatus for removing constituent from a fluid stream, the apparatus comprising:
   a duct having a fluid passageway to receive a fluid stream having constituent;
   a collection device coupled to the duct, the collection device in communication with the fluid passageway to filter the fluid stream;
   a sorbent injector to inject a sorbent in the fluid passageway of the duct, wherein the injection of the sorbent into the fluid passageway is upstream of the collection device; and
   an acoustic generator to generate an acoustic field in the fluid passageway of the duct to promote sorption of at least some of the constituent for collection by the collection device.

2. The apparatus of Claim 1, wherein the acoustic generator is further defined as an array of sound sources mounted along the duct to produce a plurality of acoustic fields in the fluid passageway of the duct.

3. The apparatus of Claim 1, wherein the acoustic field is further defined as having a peak sound pressure level referenced to 20 microPascals of 130 to 170 dB.

4. The apparatus of Claim 1, wherein the acoustic field is further defined as having frequencies in the range 5 Hz to 30 kHz.

5. The apparatus of Claim 1, wherein the acoustic field is further defined as having a sinusoidal waveform.

6. The apparatus of Claim 1, wherein the acoustic field is further defined as having a modulated waveform.

7. The apparatus of Claim 1, wherein the acoustic field is further defined as having a periodic waveform.

8. The apparatus of Claim 1, wherein at least a portion of the constituent is vapor.

9. The apparatus of Claim 1, wherein at least a portion of the constituent is mercury and wherein the sorbent is powdered or granular.

10. The apparatus of Claim 9, wherein the mercuryis oxidized mercury.

11. The apparatus of Claim 9, wherein the mercury is elemental mercury.

12. The apparatus of Claim 9, wherein the sorbent is activated carbon.

13. The apparatus of Claim 1, wherein at least a portion of the constituent is an oxide of sulfur and wherein the sorbent is a limestone slurry.

14. The apparatus of Claim 1, wherein at least a portion of the constituent is an oxide of nitrogen and wherein the sorbent is a limestone slurry.

15. The apparatus of Claim 1, wherein the apparatus further includes a second collection device upstream of the sorbent injector

16. The apparatus of Claim 15, wherein the collection device is further defined as a baghouse and wherein the second collection device is further defined as an electrostatic precipitator.

17. The apparatus of Claim 1, wherein the fluid stream is further defined as a gas exhaust stream.

18. The apparatus of Claim 17, wherein at least a portion of the constituent is mercury.

19. The apparatus of Claim 17, wherein the gas exhaust stream is further defined as gas exhaust from a coal-fired power plant.

20. The apparatus of Claim 1, further comprising:

a second acoustic generator adapted to generate a modulated acoustic field in the fluid passageway of the duct upstream of the sorbent injector to

promote agglomeration of at least a portion of the constituent in the fluid stream.

21. The apparatus of Claim 20, further comprising:

a second collection device coupled downstream of a point of application of the modulated acoustic field, the collection device in communication with the fluid passageway to promote removal of the agglomerated constituent.

22. The apparatus of Claim 21, wherein the modulated acoustic field is further defined as frequency modulated.

23. The apparatus of Claim 21, wherein the modulated acoustic field is further defined as amplitude modulated.

24. The apparatus of Claim 1, wherein the apparatus further comprises:

a hopper operably positioned to accumulate at least a portion of the constituent removed from the fluid stream.

25. The apparatus of Claim 1, wherein the collection device is a filter.

26. The apparatus of Claim 1, wherein the collection device is an electrostatic precipitator.

27. The apparatus of Claim 1, wherein the collection device is a baghouse.

28. The apparatus of Claim 1, wherein the collection device is a cyclone separator.

29. The apparatus of Claim 1, wherein the collection device is a gravitational settling chamber.

30. The apparatus of Claim 1, wherein at least a portion of the constituent is fly ash.

31. The apparatus of Claim 1, wherein the acoustic field is defined as a sinusoidal wave.

32. The apparatus of Claim 1, wherein the acoustic field is frequency modulable.

33. The apparatus of Claim 1, wherein the acoustic field is amplitude modulable.

34. The acoustic agglomerator of Claim 33, wherein the acoustic field is frequency modulable.

35. The apparatus of Claim 1, further comprising: wherein the fluid stream is a combustion gas from a power plant.

36. The apparatus of Claim 35, wherein the power plant is a coal fired power plant.

37. The apparatus of Claim 35, wherein the power plant is a lignite fired power plant.

38. The apparatus of Claim 35, wherein the power plant is a natural gas fired power plant.

39. The apparatus of Claim 35, wherein the power plant is a municipal waste fired power plant.

40. The apparatus of Claim 35, wherein the power plant is a diesel power generator.

41. The apparatus of Claim 35, wherein the power plant is an agricultural fired power plant.

42. The apparatus of Claim 1, wherein
the acoustic generator is a plurality of acoustic generators; and
each of the plurality of acoustic generators is adapted to generate a modulated acoustic field in the duct.

43. The apparatus of Claim 42, wherein each of the plurality of acoustic generators is adapted to generate a frequency modulated acoustic field.

44. The apparatus of Claim 43, wherein each of the plurality of acoustic generators is adapted to generate a frequency modulated acoustic field unique relative to each of the other plurality of acoustic generators.

45. The acoustic agglomerator of Claim 42, wherein each of the plurality of acoustic generators is adapted to generate an amplitude modulated acoustic field.

46. The acoustic agglomerator of Claim 45, wherein each of the plurality of acoustic generators is adapted to generate an amplitude modulated acoustic field unique relative to each of the other plurality of acoustic generators.

47. The apparatus of Claim 1, further comprising:
an emissions analyzer, operable to receive information concerning the fluid stream.

48. The apparatus of Claim 47, wherein a frequency of the sound field is selected based upon information received from the emissions analyzer, concering the fluid stream.

49. A method for removing constituent from a fluid stream, comprising:
injecting a sorbent in the fluid stream, the fluid stream having constituent; and
applying an acoustic field in the fluid stream to promote sorption of at least some of the constituent.

50. The method of Claim 49, further comprising:
providing a collection device, wherein

the collection devices is in communication with the fluid stream; and

the collection device is downstream relative to a point wherein the sorbent is injected into the fluid stream.

51. The method of Claim 49, wherein the step of applying an acoustic field in the fluid stream further includes:

providing an array of sound sources to produce a plurality of acoustic fields in the fluid passageway of the duct.

52. The method of Claim 49, wherein the acoustic field in the step of applying an acoustic field in the fluid stream has a sound pressure level referenced to 20 microPascals in the range of 130 to 170 dB.

53. The method of Claim 49, wherein the acoustic field in the step of applying an acoustic field in the fluid stream has a frequencies in the range 5 Hz to 30 kHz.

54. The method of Claim 49, wherein the acoustic field in the step of applying an acoustic field in the fluid stream has a sinusoidal waveform.

55. The method of Claim 49, wherein the acoustic field in the step of applying an acoustic field in the fluid stream has a modulated waveform.

56. The method of Claim 49, wherein the acoustic field in the step of applying an acoustic field in the fluid stream has a periodic waveform.

57. The method of Claim 49, wherein at least a portion of the constituent is vapor.

58. The method of Claim 49, wherein at least a portion of the constituent is mercury and wherein the sorbent is powdered or granular.

59. The method of Claim 58, wherein the sorbent is activated carbon.

60. The method of Claim 49, wherein at least a portion of the constituent is an oxide of sulfur and wherein the sorbent is a limestone slurry.

61. The method of Claim 49, wherein at least a portion of the constituent is an oxide of nitrogen and wherein the sorbent is a limestone slurry.

62. The method of Claim 49, further comprising: providing a second collection device upstream of the sorbent injector.

63. The method of Claim 49, wherein the fluid stream is further defined as a gas exhaust stream.

64. The method of Claim 63, wherein at least a portion of the constituent is mercury.

65. The method of Claim 63, wherein the gas exhaust stream is further defined as gas exhaust from a coal-fired power plant.

66. The method of Claim 49, further comprising:
providing a hopper operably positioned to accumulate at least a portion of the constituent removed from the fluid stream.

67. The method of Claim 49, further comprising:
filtering the fluid stream with a collection device.

68. The method of Claim 67, wherein the collection device is a filter.

69. The method of Claim 67, wherein the collection device is an electrostatic precipitator.

70. The method of Claim 67, wherein the collection device is a baghouse.

71. The method of Claim 67, wherein the collection device is a cyclone separator.

72. The method of Claim 67, wherein the collection device is a gravitational settling chamber.

73. The method of Claim 67, further comprising:
providing a second acoustic generator adapted to generate a modulated acoustic field in the fluid

passageway of the duct upstream of the sorbent injector to promote agglomeration of at least a portion of the constituent in the fluid stream.

74. The method of Claim 73, further comprising:
providing a second collection device coupled downstream of a point of application of the modulated acoustic field, the second collection device in communication with the fluid passageway to promote removal of the agglomerated constituent.

75. The method of Claim 74, wherein the modulated acoustic field is further defined as frequency modulated.

76. The method of Claim 74, wherein the modulated acoustic field is further defined as amplitude modulated.

77. The method of Claim 49, wherein at least a portion of the constituent is a fly ash.

78. The method of Claim 49, further comprising:
determining a frequency of the acoustic field to apply to the fluid stream.

79. The method of Claim 78, wherein the step of determining a frequency further comprises:
selecting a sound pressure level of the acoustic field;

calculating a time harmonic acoustic displacement of the fluid stream;

calculating a time harmonic displacement of an agent particle in response to the acoustic field and an associated viscous drag effect;

calculating a relative displacement amplitude of the agent particle by subtracting the displacement of the agent particle from the displacement of the fluid stream; and

calculating the relative displacement over a plurality of frequencies to produce a curve such that the curve includes a global maximum wherein the global maximum is the frequency determined.

80. The method of Claim 78, wherein the step of determining frequency further comprises:

applying a model based upon parameters of the fluid stream.

81. The method of Claim 78, wherein the step of determining frequency further comprises:

observing the transfer of the constituent towards the sorbent over several frequencies; and

selecting the frequency that provide the greatest transfer of the sorbent.

82. An apparatus for removing constituent from a fluid stream, the apparatus comprising:

a scrubber tower having a chamber defining a fluid passageway to receive a fluid stream having constituent;

a liquid injector coupled to the scrubber tower, the liquid injector operable to inject a liquid agent in the scrubber tower;

an acoustic generator to generate an acoustic field in the chamber of the scrubber tower to promote a chemical reaction between the liquid agent and at least some of the constituent.

83. The apparatus of Claim 82, wherein at least a portion of the constituent includes sulfur oxides.

84. The apparatus of Claim 82, wherein at least a portion of the constituent includes nitrogen oxides.

85. The apparatus of Claim 84, wherein at least a portion of the constituent includes sulfur oxides.

86. The apparatus of Claim 82, wherein at least a portion of the constituent includes mercury.

87. The apparatus of Claim 86, wherein the mercury is elemental mercury.

88. The apparatus of Claim 86, wherein the mercury is oxidized mercury.

89. The apparatus of Claim 82, wherein the scrubber tower is a packed scrubber tower.

90. The apparatus of Claim 82, wherein the scrubber tower is a spray scrubber tower.

91. The apparatus of Claim 82, wherein the liquid agent is a limestone slurry for removing sulfur oxides.

92. The apparatus of Claim 82, wherein the liquid agent is a limestone slurry for removing nitrogen oxides.

93. The apparatus of Claim 92 wherein the limestone slurry further removes sulfur oxides.

94. The apparatus of Claim 82, wherein the liquid agent is a limestone slurry and at least a portion of the constituent includes mercury.

95. The apparatus of Claim 94, wherein the mercury is elemental mercury.

96. The apparatus of Claim 94, wherein the mercury is oxidized mercury.

97. The apparatus of Claim 82, wherein the acoustic generator is further defined as an array of sound sources to generate the acoustic field.

98. The apparatus of Claim 82, wherein the sound field has a peak sound pressure level, referenced to 20 microPascals, in the range of 130 to 170 dB and frequencies in the range 5 Hz to 30 kHz and wherein the acoustic field is further defined as having a sinusoidal waveform.

99. The apparatus of Claim 82, wherein the sound field has a peak sound pressure level, referenced to 20 microPascals, in the range of 130 to 170 dB and frequencies in the range 5 Hz to 30 kHz and wherein the acoustic field is further defined as having a modulated.

100. The apparatus of Claim 82, wherein the sound field has a peak sound pressure level, referenced to 20 microPascals, in the range of 130 to 170 dB and frequencies in the range 5 Hz to 30 kHz and wherein the acoustic field is further defined as having a general period waveform.

101. The apparatus of Claim 82, wherein the fluid stream is further defined as a gas exhaust from a coal-fired power plant.

102. A method of enhancing mass transfer from a dilute vapor towards the surface of a sorbent, the method comprising:
providing a fluid stream having a dilute vapor;
injecting a sorbent having a surface into the fluid stream; and
applying an acoustic field to the fluid stream to promote diffusion of the dilute vapor toward the surface of the sorbent.

103. The method of Claim 102, further comprising:
providing a collection device to collect the sorbent and vapor that reacts with the sorbent.

104. The method of Claim 102, wherein the diffusion of the vapor towards the surface of the sorbent is a physical adsorption.

105. The method of Claim 102, wherein the diffusion of the vapor towards the surface of the sorbent is a chemical absorption.

106. The method of Claim 102, wherein
the vapor is a constituent of a fluid stream;
the fluid stream is a gas exhaust from a coal fired power plant;
the vapor is elemental or oxidized mercury; and
the sorbent is activated carbon.

107. The method of Claim 102, wherein the acoustic field is generated by an array of sound sources.

108. A method of enhancing mass transfer from a dilute vapor towards the surface of a sorbent, the method comprising:
providing a gas stream having a dilute vapor;
injecting a liquid spray into the fluid stream;
applying an acoustic field to the fluid stream to promote removal of the dilute vapor; and
providing a collection device to collect the liquid which has chemically reacted with the dilute vapor.

109. The method of Claim 108, wherein the liquid spray is a liquid spray droplet or liquid layer on packing material that acts to remove the dilute vapor by chemical reaction.

110. The method of Claim 108, wherein at least a portion of the dilute vapor is a sulfur oxide and the fluid stream is a gas exhaust from a coal-fired power plant.

111. The method of Claim 108, wherein at least a portion of the dilute vapor is a nitrogen oxide and the fluid stream is a gas exhaust from a coal-fired power plant.

112. The method of Claim 111 wherein at least a portion of the dilute vapor is a sulfur oxide.

113. The apparatus of Claim 108, wherein at least a portion of the dilute vapor includes mercury.

114. The apparatus of Claim 113, wherein the mercury is elemental mercury.

115. The apparatus of Claim 113, wherein the mercury is oxidized mercury.

116. The method of Claim 108, wherein the liquid spray is a limestone slurry.

117. The method of Claim 108, the acoustic field is generated by an array of sound sources.

118. The method of Claim 108, wherein the fluid stream is provided in a scrubber tower that utilizes a high surface area packing material.

119. The method of Claim 108, wherein the fluid stream is provided in a scrubber tower that utilizes a high surface area spray.

120. The method of Claim 119, wherein the fluid stream is provided in a scrubber tower that further utilizes packing material.

121. A method of determining a frequency of sound to increase the acoustical stimulation of vapor diffusion, the method comprising:

selecting a sound pressure level of an acoustic field;

calculating a time harmonic acoustic displacement of a fluid stream;

calculating a time harmonic displacement of an agent particle in response to the acoustic field and an associated viscous drag effect;

calculating a relative displacement amplitude of the agent particle by subtracting the displacement of the agent particle from the displacement of the fluid stream;

calculating the relative displacement over a plurality of frequencies to produce a curve such that the curve includes a global maximum wherein the global maximum is the frequency to increase the acoustical stimulation of vapor diffusion.

122. The method of claim 121, wherein the agent particle is selected from a group consisting of a spray droplet, a liquid film or a sorbent.

123. The method of claim 122, wherein the sorbent is powdered of granular.

124. A method for extending the useful life of a filtration device, the method comprising:
providing a duct defining a fluid passageway;
providing a filtration device, operable to filter a fluid stream;
injecting a sorbent in the fluid stream;
applying an acoustic field in the fluid stream to promote sorption of at least some of the constituent; and
collecting the at least some of the constituent and at least some of the sorbent with the filtration device; and
removing the at least some of the constituent and the at least some of the sorbent from the filtration device to clean the filtration device.

125. The method of Claim 124, wherein the fluid stream is a gas stream.

126. The method of Claim 124, wherein the fluid stream is a liquid stream.

127. A method for enhancing transfer of constituent in a fluid towards a surface of a sorbent, comprising:

providing a fluid with a constituent;

injecting a sorbent having a surface into the fluid; and

applying a modulated acoustic field to the fluid to promote transfer of the constituent towards the surface of the sorbent.

128. The method of Claim 127, wherein the fluid is provided in an open area and wherein the modulated acoustic field is applied to the open area to cause the constituent to transfer towards the surface of the sorbent.

129. The method of Claim 127, wherein the acoustic field is applied in a direction angularly arbitrary to a direction of flow of the fluid stream through the fluid passageway.

130. The method of Claim 127, wherein the fluid is provided in a chamber and wherein the modulated acoustic field is applied to the fluid in the chamber to cause the constituent to transfer towards the surface of the sorbent.

131. The method of Claim 127, wherein the fluid is provided in a fluid passageway and wherein the modulated acoustic field is applied to the fluid in the fluid passageway to cause the constituent to transfer towards the surface of the sorbent.

132. The method of Claim 131, wherein the fluid passageway is further defined as a duct having a sidewall defining a passageway adapted to communicate the fluid.

133. The method of Claim 132, wherein the duct is further defined as an exhaust duct.

134. The method of Claim 132, wherein the duct has a substantially circular cross-section.

135. The method of Claim 132, wherein the duct has a substantially oval cross-section.

136. The method of Claim 132, wherein the duct has a substantially rectangular cross-section.

137. The method of Claim 127, further comprising:
applying a plurality of acoustic fields to the fluid; and
modulating the plurality of acoustic fields to cause the constituent to agglomerate.

138. The method of Claim 127, wherein the acoustic field is frequency modulable

139. The method of Claim 138, wherein the acoustic field is amplitude modulable.

140. The method of Claim 139, wherein the frequency of the acoustic field is modulable in a range of up to 1 GHz

and wherein the amplitude of the acoustic field is modulable in a range of up to 200 dB referenced to 20 micro-Pascals.

141. The method of Claim 139, wherein the frequency of the acoustic field is modulable in a range of up to 20 kHz and wherein the amplitude of the acoustic field is modulable in a range of up to 200 dB referenced to 20 micro-Pascals.

142. The method of Claim 139, wherein the frequency of the acoustic field is modulable in a range of from about 50 Hz to about 15 kHz and wherein the amplitude of the acoustic field is modulable in a range of from about 130 dB to about 175 dB referenced to 20 micro-Pascals.

143. The method of Claim 127, wherein the fluid is a liquid.

144. The method of Claim 127, wherein the fluid is a gas stream.

145. The method of Claim 127, wherein the fluid is a combustion exhaust gas.

146. The method of Claim 145, wherein at least a portion of the constituent is fly ash.

147. The method of Claim 127, wherein the acoustic field is frequency modulable and wherein the acoustic field is amplitude modulable.

148. The method of Claim 147, wherein the frequency modulation of the acoustic field is further defined as increasing the frequency of the acoustic field.

149. The method of Claim 147, wherein the frequency modulation of the acoustic field is further defined as decreasing the frequency of the acoustic field.

150. The method of Claim 127, wherein the acoustic field is exponentially modulated.

151. The method of Claim 127, wherein a frequency of the acoustic field is modulated linearly.

152. The method of Claim 127, wherein a frequency of the acoustic field is modulated non-linearly.

153. The method of Claim 127, wherein a modulation of the acoustic field is applied for a periodic interval.

154. A method for enhancing transfer of constituent in a fluid towards a surface of a sorbent, comprising:
providing a fluid with constituent;
injecting a sorbent having a surface into the fluid;
applying an acoustic field to the fluid; and
frequency modulating the acoustic field to promote transfer of the constituent towards the surface of the sorbent.

155. The method of Claim 154, wherein the fluid is provided in an open area and wherein the frequency modulated acoustic field is applied to the open area to cause the constituent to transfer towards the surface of the sorbent.

156. The method of Claim 154, wherein the fluid is provided in a chamber and wherein the frequency modulated acoustic field is applied to the fluid in the chamber to cause the constituent to transfer towards the surface of the sorbent.

157. The method of Claim 154, wherein the fluid is provided in a fluid passageway and wherein the frequency modulated acoustic field is applied to the fluid in the fluid passageway to cause the constituent to transfer towards the surface of the sorbent.

158. The method of Claim 157, wherein the fluid passageway is further defined as a duct having a sidewall defining a passageway adapted to communicate the fluid.

159. The method of Claim 158, wherein in the duct is further defined as an exhaust duct.

160. The method of Claim 154, further comprising:
applying a plurality of acoustic fields to the fluid; and

frequency modulating the plurality of acoustic fields to cause the constituent to transfer towards the surface of the sorbent.

161. The method of Claim 160, wherein the frequency modulation of each of the plurality of acoustic fields are substantially similar.

162. The method of Claim 160, wherein the frequency modulation of each of the plurality of acoustic fields are substantially different.

163. The method of Claim 154, wherein the acoustic field is further defined has having a frequency in a range of up to 1 GHz.

164. The method of Claim 154, wherein the acoustic field is further defined has having a frequency in a range of up to 20 kHz.

165. The method of Claim 154, wherein the acoustic field is further defined has having a frequency in a range of from about 50 Hz to about 15 kHz.

166. The method of Claim 154, wherein the acoustic field has an initial frequency and wherein the acoustic field is frequency modulated relative to the initial frequency to cause the constituent to transfer towards the surface of the sorbent.

167. The method of Claim 166, wherein the acoustic field is modulated to a first frequency substantially less than the initial frequency.

168. The method of Claim 166, wherein the acoustic field is modulated to a first frequency substantially greater than the initial frequency.

169. The method of Claim 167, wherein the acoustic field is modulated to a second frequency substantially greater than the first frequency.

170. The method of Claim 167, wherein the acoustic field is modulated to a second frequency substantially greater than the initial frequency.

171. The method of Claim 168, wherein the acoustic field is modulated to a second frequency substantially less than the first frequency.

172. The method of Claim 168, wherein the acoustic field is modulated to a second frequency substantially less than the initial frequency.

173. The method of Claim 154, wherein the fluid is further defined as a liquid.

174. The method of Claim 154, wherein the fluid is further defined as a gas.

175. The method of Claim 154, wherein the fluid is further defined as a combustion exhaust gas.

176. The method of Claim 175, wherein the combustion gas exhaust includes fly ash.

177. An apparatus for removing constituent from a fluid stream, the apparatus comprising:
a duct having a sidewall defining a fluid passageway, the duct adapted to receive a fluid stream having the constituent;
a manifold system coupled to the duct such that the manifold system communicates with the fluid passageway;
a sorbent injector to inject a sorbent in the fluid passagway of the duct; and
at least a first sound source coupled to the manifold system and operable to generate an acoustic field in the fluid passageway of the duct to promote sorption of at least some of the constituent.

178. The apparatus of Claim 177, wherein the at a least first sound source is further defined as an electrodynamic compression driver.

179. The apparatus of Claim 177, wherein the at least first sound source is further defined as operable to generate a sound pressure level of at least 150 dB referenced to 20 micro-Pascals at a range of 2 meters.

180. The apparatus of Claim 179, wherein the manifold

system further includes a main chamber in communication with the fluid passageway of the duct and at least a first channel in communication with the main chamber.

181. The apparatus of Claim 180, wherein the manifold system is further defined as having a plurality of channels in communication with the main chamber.

182. The apparatus of Claim 181, wherein
the at least a first sound source is a plurality of sound sources; and
each of the plurality of sound sources is coupled to one of the plurality of channels in communication with the main chamber.

183. The apparatus of Claim 182, wherein the manifold system, including the plurality of channels in communication with the main chamber and the plurality of sound sources each coupled to one of the plurality of channels, defines a compression driver array and wherein a plurality of compression driver arrays are operably coupled to generate a modulated acoustic field within the fluid passageway of the duct.

184. The apparatus of Claim 177, wherein the acoustic field is frequency modulable.

185. The apparatus of Claim 184, wherein the acoustic field is further defined as amplitude modulable.

186. The apparatus of Claim 177, wherein the acoustic field is amplitude modulable.

187. The apparatus of Claim 186, wherein the frequency of the acoustic field is modulable in a range of up to 1 GHz and wherein the amplitude of the acoustic field is modulable in a range of up to 200 dB referenced to 20 micro-Pascals.

188. The apparatus of Claim 186, wherein the frequency of the acoustic field is modulable in a range of up to 20 kHz and wherein the amplitude of the acoustic field is modulable in a range of up to 200 dB referenced to 20 micro-Pascals.

189. The apparatus of Claim 186, wherein the frequency of the acoustic field is modulable in a range of from about 50 Hz to about 15 kHz and wherein the amplitude of the acoustic field is modulable in a range of from about 130 dB to about 175 dB referenced to 20 micro-Pascals.

190. An apparatus for removing constituent from a fluid stream, the apparatus comprising:

a fluid passageway, operable to receive a fluid stream having constituent;

a collection device in communication with the fluid passageway, the collection device operable to filter the fluid stream;

a substance having a reacting surface, operable to react with the constituent; and

an acoustic generator to generate an acoustic field in the fluid passageway to promote reaction of at least some of the constituent with the reacting surface of the substance for collection by the collection device.

191. The apparatus of Claim 190, wherein the substance having a reacting surface and the collection device are part of a fixed bed adsorber.

192. The apparatus of Claim 190, wherein the substance having a reacting surface and the collection device are part of a catalytic converter.

193. The apparatus of Claim 190, wherein the substance having a reacting surface and the collection device are part of a packed scrubber tower.

194. The apparatus of Claim 190, wherein the substance having a reacting surface and the collection device are part of a spray scrubber tower.

195. The apparatus of Claim 190, wherein the substance having a reacting surface is a sorbent injected into the fluid passageway with a sorbent injector.

196. The apparatus of Claim 190, wherein
the acoustic field further includes a frequency; and
the frequency is determined from a model that calculates an optimum frequency from parameters of the fluid stream.

197. The apparatus of Claim 190, wherein
the acoustic field further includes a frequency; and
the frequency is determined from an observance of an effect of several frequencies on the fluid stream.